

3. We submit that an invention disclosure Docket No 48-0057, attached hereto as Exhibit A, was written and submitted to Lorna L. Schott, Patent Administrator for Northrop Grumman Space & Mission Systems Corp. Space Technology. The invention disclosure

describes a Date of First Written Description of the Invention at a date prior to October 31, 2002, and thereby establishes conception and support of at least the systems, methods, and devices recited in claims 1, 3-6, 14-17, 19, and 22-26 prior to October 31, 2002. Specifically, the fifth paragraph under the heading "Inventive Concept" on page 5 of 9, the first six paragraphs under the heading "Invention Description and Operation" beginning on page 5 of 9 and continuing into page 6 of 9, and Figure 1 on page 7 of 9 support these claims.

4. On or about January 18-19, 2003, I and my co-inventor Frank Winter had meetings with Christopher Harris and Gary Pitzer on eight Northrop Grumman Patent disclosures of which Mr. Harris and Mr. Pitzer were assigned to prepare and file patent applications on the respective subject matter of each disclosure. The disclosures included Northrop Grumman Docket Nos. 20-0191, 48-0040, 48-0041, 48-0045, 48-0049, 48-0043, 48-0046, and 48-0042.

5. On or about January 27, 2003, Frank Winter and I had a teleconference with Christopher Harris regarding two new invention disclosures: Northrop Grumman Docket No. 48-0057, which discloses the subject matter of the present application, and Northrop Grumman Docket No. 48-0058. This teleconference and receipt of these invention disclosures is described in an email from Lorna L. Schott on January 27, 2003, to Christopher Harris. The email is attached hereto as Exhibit B.

6. During the course of the next 4-6 months, I reviewed and commented on some or all of the ten draft patent applications written from the above-mentioned ten patent disclosures.

7. On May 8, 2003, Christopher Harris contacted me via email to request that I review a draft application for the above-identified patent application Serial No. 10/606,721 for technical accuracy and completeness. The email included an electronic copy of a draft of the Application. The email is attached hereto as Exhibit C. A copy of the draft of the Application is attached hereto as Exhibit D.

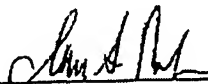
8. At some time prior to June 21, 2003, I sent an email to Christopher Harris containing my comments and revisions regarding the draft of the Application.

9. On the morning of June 21, 2003, Christopher Harris provided a revised second draft of the Application via email. A copy of that email is attached hereto as Exhibit D.

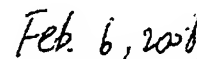
10. On June 23, 2003, I received electronic copies of the Application and a set of formal papers via email from Christopher Harris. A copy of that email is attached as Exhibit E. I signed the formal papers confirming that I am a coinventor of the invention described in the Application and assigning my interest in any patent granted from the Application to Northrop Grumman Corporation. I then promptly mailed the signed papers back to Christopher Harris for submission with the Application.

11. I believe that the Application was filed in the U.S. Patent Office on June 26, 2003.

12. I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under §1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.



Ian Robinson



Date

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:)
)
Ian Robinson, et al.) Group Art Unit: 2611
)
Serial No.: 10/606,721)
)
Filed: June 26, 2003) Examiner: Kevin Michael Burd
)
For: *Communication System and Method for Improving Efficiency*

DECLARATION UNDER 37 C.F.R. §1.131

Sir:

I, the undersigned, declare as follows:

1. I, Frank Winter, am an inventor of the invention entitled Communication System and Method for Improving Efficiency, disclosed and claimed in U.S. Patent Application Serial No. 10/606,721 (hereinafter to as "the Application"), which was filed on June 26, 2003.

2. I along with my co-inventor, Ian Robinson, conceived the subject matter that is disclosed and claimed in the Application prior to October 31, 2002, while employed by the Assignee.

3. We submit that an invention disclosure Docket No 48-0057, attached hereto as Exhibit A, was written and submitted to Lorna L. Schott, Patent Administrator for Northrop Grumman Space & Mission Systems Corp. Space Technology. The invention disclosure describes a Date of First Written Description of the Invention at a date prior to October 31, 2002, and thereby establishes conception and support of at least the systems, methods, and devices recited in claims 1, 3-6, 14-17, 19, and 22-26 prior to October 31, 2002. Specifically, the fifth paragraph under the heading "Inventive Concept" on page 5 of 9, the first six paragraphs under

the heading "Invention Description and Operation" beginning on page 5 of 9 and continuing into page 6 of 9, and Figure 1 on page 7 of 9 support these claims.

4. On or about January 18-19, 2003, I and my co-inventor Ian Robinson had meetings with Christopher Harris and Gary Pitzer on eight Northrop Grumman Patent disclosures of which Mr. Harris and Mr. Pitzer were assigned to prepare and file patent applications on the respective subject matter of each disclosure. The disclosures included Northrop Grumman Docket Nos. 20-0191, 48-0040, 48-0041, 48-0045, 48-0049, 48-0043, 48-0046, and 48-0042.

5. On or about January 27, 2003, Frank Winter and I had a teleconference with Christopher Harris regarding two new invention disclosures: Northrop Grumman Docket No. 48-0057, which discloses the subject matter of the present application, and Northrop Grumman Docket No. 48-0058. This teleconference and receipt of these invention disclosures is described in an email from Lorna L. Schott on January 27, 2003, to Christopher Harris. The email is attached hereto as Exhibit B.

6. During the course of the next 4-6 months I reviewed and commented on some or all of ten draft patent applications written from the above-mentioned ten patent disclosures.


7. On June 23, 2003, I received electronic copies of the Application and a set of formal papers via email from Christopher Harris. A copy of that email is attached as Exhibit E. I signed the formal papers confirming that I am a coinventor of the invention described in the Application and assigning my interest in any patent granted from the Application to Northrop Grumman Corporation. I then promptly mailed the signed papers back to Christopher Harris for submission with the Application.

8. I believe that the Application was filed in the U.S. Patent Office on June 26, 2003.

Serial No. 10/606,721

Docket No. NG(ST)-6445

9. I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under §1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.



Frank Winter

02-11-2008

Date

Invention Disclosure Form – Part 1

EXHIBIT

tabbies

A

Jump to:

[Disclosure Form Instructions & Patent FAQ](#) (For context specific instructions, click on the section heading)

Disclosure Form Section:

[Conception of Invention](#)

[Construction & Test](#)

[Contract or Project Information](#)

[Offer for Sale](#)

[Public Use](#)

[Publication](#)

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[Technical Evaluation](#)

[Market Evaluation](#)

Invention Title and Date of this Disclosure Form

Docket: 48-0057

Date: November 27 2002

Title of Invention: Communications System Enabling High Efficiency and High Linearity

Conception of Invention

Date of First Written Description of the Invention: October 5, 2002

Identify the Written Description and Indicate Where Located: Hard drive of inventor

Date of the First Oral Disclosure:	<u>Unknown</u>	To Whom:	<u></u>
Date of First <u>Sketches</u> or Formal Drawings:	<u>November 24, 2002</u>	Present Location of Sketches or Drawings:	<u>Hard drive of Inventor</u>
<input type="checkbox"/> Drawings		<input checked="" type="checkbox"/> x	

(Please Obtain All Signatures Before Sending to Lorna Schott, Intellectual Asset Management)

Inventor:	Date:	Inventor:	Date:	Inventor:	Date:
Inventor:	Date:	Inventor:	Date:	Inventor:	Date:
Witnessed, Read and Understood by:	Witness:	Date:	Supervisor:	Date:	

Construction And Test Please attach a copy of any dated test reports (or relevant portions).Invention Simulated /
Modeled?Yes ☐No ☒

Date: _____

By Whom: _____

Invention Physically
Constructed?Yes ☐No ☒

Date: _____

By Whom: _____

Invention Successfully
Tested?Yes ☐No ☒

Date: _____

By Whom: _____

Contract or Project InformationThe Invention First **Conceived** While Charging Time to Job No.: 94KKAC

And Working On:

Government Contract or
Subcontract No.: _____

Title: _____

TRW Funded (IR&D, B&P,
PM&P) Project No.: _____02412007

Title: _____

Universal Base Transceiver StationCommercial Contract
Name or Number: _____

Customer: _____

Other, _____

Contract Administrator and Phone No.: _____

The Invention First **Constructed** While Charging Time to Job
No.: _____

And Working On:

Government Contract or Subcontract
No.: _____

Title: _____

TRW Funded (IR&D, B&P,
PM&P) Project No.: _____

Title: _____

Commercial Contract
No.: _____

Customer: _____

Other, _____

Contract Administrator and Phone
No.: _____

(Please Obtain All Signatures Before Sending to Lorna Schott, Intellectual Asset Management)

Inventor:	Date:	Inventor:	Date:	Inventor:	Date:
Inventor:	Date:	Inventor:	Date:	Inventor:	Date:
Witnessed, Read and Understood by:		Witness:	Date:	Supervisor:	Date:

Offer For Sale

Was invention disclosed to a non-TRW employee in the course of negotiation or execution of a sales transaction, or is such a disclosure imminent? Yes ☐ No ☒

Is it anticipated that an activity will occur soon? Please provide the appropriate information below and enter expected date. Yes ☐ No ☒

(If no, continue to Public Use section)

Date of First Executed Sales Contract: _____

Identify First Sales Contract No.: _____

Date Of First Delivery To Customer: _____

Was Invention Described in a Proposal? Yes ☐ No ☐ Date: _____

Was a Description of the Invention Provided to the Government? Yes ☐ No ☐ Date: _____

Was a Description of the Invention Provided to a Commercial Customer? Yes ☐ No ☐ Date: _____

Was a Description of the Invention Provided as Part of an On-going Contract? Yes ☐ No ☐ Date: _____

If you answered YES to any of the above questions, please provide a copy of the material which included the description.

Public Use

Has the invention been used in a public setting? Yes ☐ No ☒

If the invention is a manufacturing method or machine, has the invention been used to produce products delivered or deliverable to a customer? Yes ☐ No ☒

If the invention is a product, has the product been delivered to someone outside TRW? Yes ☐ No ☒

If you answered YES to any of the above questions, please provide details.

Publication

Has a Description of the Invention Been Published or Described in a Customer Report? Yes ☐ No ☒

(Please Obtain All Signatures Before Sending to Lorna Schott, Intellectual Asset Management)

Inventor:	Date:	Inventor:	Date:	Inventor:	Date:
Inventor:	Date:	Inventor:	Date:	Inventor:	Date:
Witnessed, Read and Understood by:		Witness:	Date:	Supervisor:	Date:

If Yes, **Provide a Copy** and Identify Publication by Name, Customer, Date, and Number:

Did the Customer Report Have a TRW Proprietary Legend? Yes ☐ No ☐

Has the Invention Been Described to People Not Employed by TRW? Yes ☐ No ☒

If Yes (A) Was Disclosure Under a Confidential Disclosure Agreement?

(B) Provide Names of Person(S), Their Employers(S), Date, and Place of Disclosure:

Prior Art Reference Material

Identify Any Prior TRW Invention Disclosures, Patent Applications, or Issued Patents Relating to the Invention:
(Provide TRW Docket No. or Patent No. if Available)

TRW disclosure being submitted in parallel, *Transmitter with Reduced Dynamic Range and Improved Linearity*

US Patent 5,903,555 Wildhaurer

Identify Any other Patents, Printed Publications, Written Reports, or Proposals That You Are Aware Of Relating to Closely Analogous Concepts, and **Provide Copies**:

United States Patent 6,307,892

Jones October 23, 2001

Multicarrier Communication System and Method for Peak Power Control

Accompany paper by Kwok on *PAR Reduction Via Constellation Shaping*

Technical Evaluation:

Please enter codes corresponding to ALL technology areas that you believe describe your invention.

4, 5, 13

<u>Category</u>	<u>Code</u>	<u>Category</u>	<u>Code</u>
Antennas	1	Military	10
Automotive Electronics	2	Miscellaneous	11
Avionics	3	Photonics	12
Communication Systems	4	Satellite Communications	13
Electronics	5	Semiconductors	14
Energy Systems	6	Sensors	15
Lasers	7	Space	16
Materials	8	Superconductors	17

(Please Obtain All Signatures Before Sending to Lorna Schott, Intellectual Asset Management)

Inventor:	Date:	Inventor:	Date:	Inventor:	Date:
Inventor:	Date:	Inventor:	Date:	Inventor:	Date:
Witnessed, Read and Understood by:	Witness:	Date:	Supervisor:	Date:	

What was the problem or need that you were trying to solve?

High Power, multi-carrier Wideband Code Division Multiple Access (WCDMA) signal amplification at much higher DC to RF efficiency than ever produced, while simultaneously meeting stringent linearity specifications.

Inventive Concept – What is new, what it does and how it does it?

The present invention is novel in that it has not been described in any publication, known patent, or known patent application. It improves on prior art techniques reducing peak communication signals to a greater degree while limiting degradations to signal error vector magnitude (EVM) and receiver bit error rate (BER) or symbol error rate (SER).

Transmitter cost, electrical consumption, and costs related to supply power and cooling can all be driven to large values by signals with high peak-to-average ratios (PARs). Signals with lower PAR and accordant peak power level can be amplified more efficiently using smaller, lower cost amplifiers, than an unmodified signal. Alternatively, a transmitter using a linear amplifier (class A, A/B, B) will provide outputs with lower distortions and reduced OOB if the peak signals are reduced. Designers can optimize the level of efficiency achieved, device size, and system linearity.

Existing techniques to reduce PAR must content with the resultant degradations to wanted signals (characterized by EVM) and out-of-band (OOB) emissions. Disclosure to be submitted *Transmitter with Reduced Dynamic Range and Improved Linearity* teaches a method to clip signals and then reduce the OOB emissions.

The present invention uses constellation shaping to avoid OOB, a technique that modifies the modulation constellation of signal to reduce peaks, deliberately introducing errors in the modulation. A bit or symbol transmitted with an erroneous modulation normally cannot be corrected at the receiver and has an increased probability of resulting in a bit or symbol error.

The present invention enables greater PAR reduction by defining one or more additional signals to be transmitted to instruct the receiver how to revise the modulation. The secondary signals can be sent in parallel or sequentially. They indicate to the receiver the nature of the modification to the modulation constellation so the modification can be partially or wholly reversed. This allows more aggressive peak reduction at the transmitter as EVM errors are repaired at the receiver. Some additional power or bandwidth or both may be needed to provide the additional signal(s) but the DC-RF efficiency and bill of materials cost of the transmitter can be markedly reduced.

This system may be used in conjunction with the methods taught in *Transmitter with Reduced Dynamic Range and Improved Linearity*

Invention Description and Operation: (Attach drawings or sketches, if available)

The present invention operates in several fashions. In all cases a signal processing function is employed to modify the modulation constellation. When a peak would normally occur the constellation is modified into one or more predefined states. Simultaneously or immediately thereafter a second signal is generated with terms that define the alterations performed to the constellation.

For example if a chip value in a coded signal ought to have a value 10 dB PAR then it is modified to be only
(Please Obtain All Signatures Before Sending to Lorna Schott, Intellectual Asset Management)

Inventor:	Date:	Inventor:	Date:	Inventor:	Date:
Inventor:	Date:	Inventor:	Date:	Inventor:	Date:
Witnessed, Read and Understood by:	Witness:	Date:	Supervisor:	Date:	

2 dB PAR and a second signal is sent so that the receiver can make the necessary adjustment. A simple system uses a minimal second signal that is zero most of the time and takes one or a small number of values coded to a fixed scaling factor when a signal is clipped.

There are preferred methods of supplying the second signal but other methods are possible. For communications using code channels (e.g. CDMA, WCDMA, CDMA2000, spread spectrum) the addition of a unique code channel(s) is easily adopted for the additional signals.

For systems using multiple carriers to convey information (e.g. OFDM, MC-CDMA, DMT) the allocation of one or a few specific frequencies can be used. It may be necessary for the receiver to buffer data for a short period to extract the additional signals.

For systems operating with TDMA it is possible to send an additional time slot with the secondary scaling information. Clearly this sacrifices some capacity for the benefits inherent in the present invention.

It is also possible to add a carrier or a polarization coded to show the additional information for nominally single carrier systems. This technique may require more extensive functions at the receiver.

It is also possible to add a code channel to signals that use other techniques.

With the addition of these techniques the PAR level of complex communications signals can be significantly decreased. Reducing a four carrier WCDMA signal from a PAR of 10 dB to a PAR of 5 dB is well within reach. This change enables a 3x reduction in amplifier size and cost and will allow a class A/B amplifier transmitter to double its DC-RF efficiency from less than 10% to almost 20%.

Figure 1 shows a preferred embodiment in the simplest terms. Many specific examples are possible.

In a second embodiment, the signal is stored briefly (e.g. in digital memory) and is decomposed into two or more replicas whose sum is the wanted signal. These replicas are added to other wanted signals, which may be similarly decomposed. The signals will appear at the receiver to be "multi-path" replicas or signals that have propagated over different paths. Receivers are already designed, for some formats (e.g. rake receivers for CDMA style signals) to recognize and re-combine multi-path versions of a signal.

Briefly describe what the prior art taught:

Prior art has taught several techniques to reduce PAR levels including modification of the modulation constellation, clipping, and selection of optimum signal components (e.g. carrier phase, code selection, frequency, code timing offset). These are techniques to limit the creation of peaks. Referencing Figure 3, selection of component control can reduce the probability of a high peak and reduce the maximum peak. In this figure 100 combinations of code offsets are selected for a four-carrier WCDMA case. Shown are the resultant minimum, median, and maximum PAR cases where there is almost a 3 dB difference in the min and max peak levels.

The TRW patent by Wilderhaur teaches a technique specific to QPSK modulation with BPSK spreading to control peak creation. Appended to this disclosure is a paper by Kwok describing constellation modification techniques. No changes to the receiver are proposed. There is additional prior art trying to optimize communications systems for communications performance but no history of optimizing for production cost and efficiency in any way similar to the present invention.

In previous wireless systems development getting increased performance (bandwidth and information content) were the priority. Standards and designs were not optimized for reducing PAR and its effects.

(Please Obtain All Signatures Before Sending to Lorna Schott, Intellectual Asset Management)

Inventor:	Date:	Inventor:	Date:	Inventor:	Date:
Inventor:	Date:	Inventor:	Date:	Inventor:	Date:
Witnessed, Read and Understood by:	Witness:	Date:	Supervisor:	Date:	

Most of the prior art has focused on changes that can be made to existing systems by modifying only the transmitter without requiring replacement of legacy receivers.

The present invention can be used with existing standards, albeit requiring modifications to legacy equipment, but may find its greatest application in future standards. The embodiment using time delayed replicas may require little or no receiver modification for CDMA-style signals.

What are the advantages to your invention (performance, cost, enabling new characteristics, etc)?

The present invention enables many transmitter architectures to operate with higher efficiency and much smaller part size and cost. A conventional four-carrier WCDMA system can save 50-100% on the most costly part of the transmitter, the final amplifier device. It can also improve its operating efficiency from less than 10% to more than 15%, resulting in a massive cost savings in base station capital equipment. The impact to the cost of future receiver designs is small.

Are there practical alternatives to the system, structure or method of the invention? That is, how easy would it be to design around the claimed invention?

No apparent alternatives are obvious.

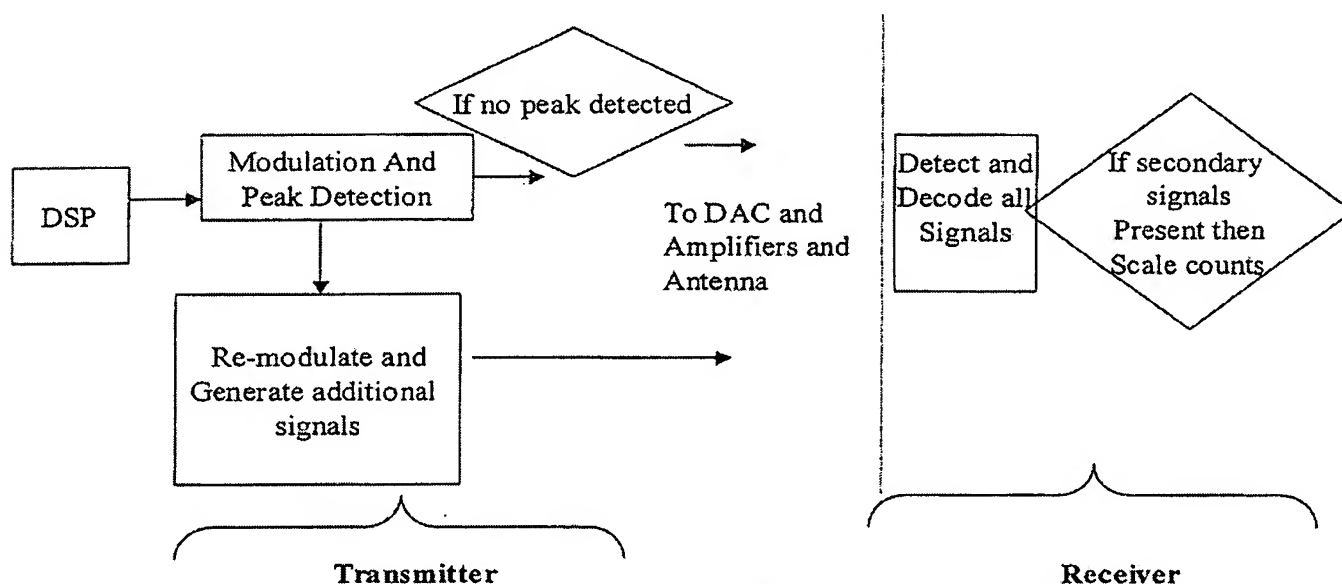


Figure 1. Logical Diagram of Preferred Embodiment

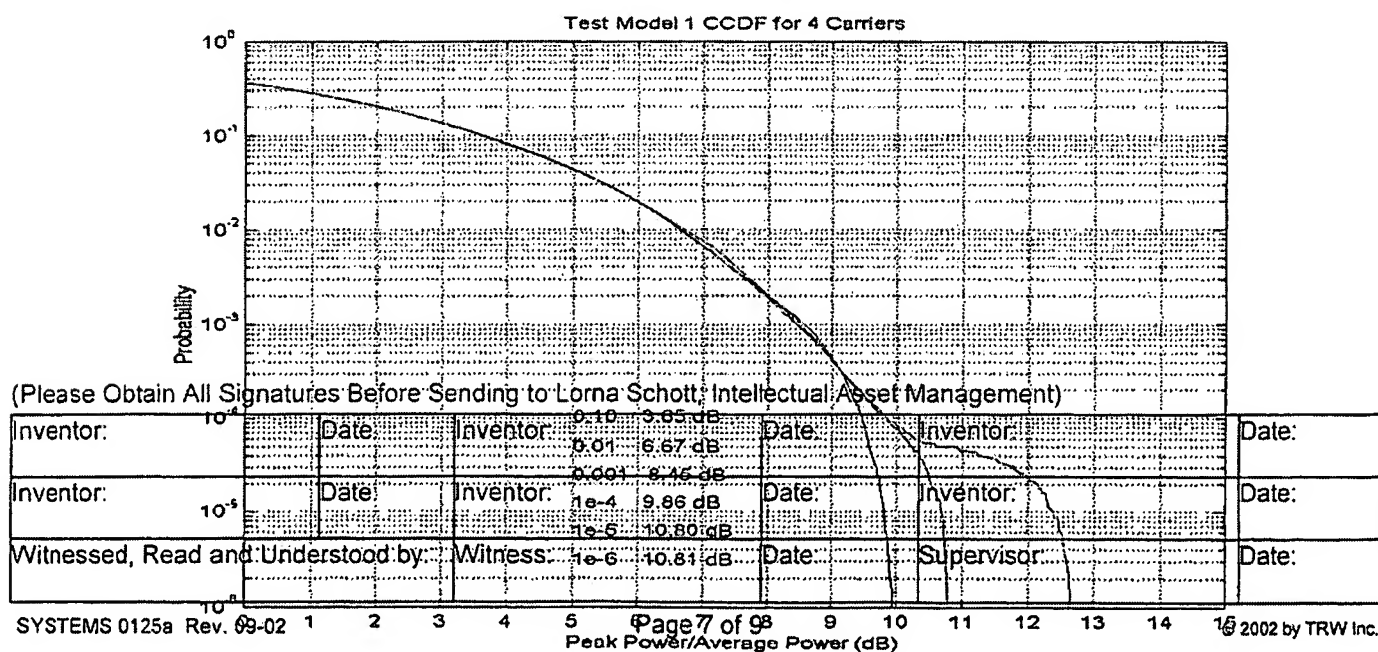


Figure 2. CCDF of WCDMA With Different Code Offsets

Market Evaluation:

Military or Defense applications:

Does the invention have only military or defense applications?

No

TRW applications:

Is the invention used in a current or planned TRW product?

Not at this time. Most likely this concept would be introduced as a future standard to which systems would be built

If Yes, describe the product and expected time to market.

Sales and Licensing Potential – please fill out this section to the best of your ability. Your answers will help us understand potential markets or licensing opportunities for your invention.

Please describe potential current or future commercial uses for your invention. List specific products that already make use of this invention, or could benefit from the use of it. Be as specific as possible.

Mobile, fixed, airborne, and space-based transmitters.

Are you aware of existing companies that might be interested in license or sale? What companies could benefit from the use of this patent? What companies compete in this technology?

Yes, NOKIA. Ericcson and Motorola are other potential users.

Is your invention easily detected? If a product were to make use of it, what would the process be to verify it?

Large scale adoption without published standards is unlikely. We will know whether this is a part of future standards.

What countries should patent applications for this invention be filed in? Why?

US, Europe and Japan are major potential markets. Possibly Korea as well. All of these regions have commercial wireless systems in place or planned that could benefit from the present invention.

(Please Obtain All Signatures Before Sending to Lorna Schott, Intellectual Asset Management)

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Inventor:	Date:	Inventor:	Date:	Inventor:	Date:
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Feel free to describe any commercial value or opportunities you feel weren't covered by these questions.

The present invention can be used with existing standards, albeit requiring modifications to legacy equipment, but may find its greatest application in future standards. As TRW becomes increasingly involved with setting new IEEE standards and through other groups (ITU, etc), concepts such as the present invention will provide some degree of leverage in the technological negotiations.

(Please Obtain All Signatures Before Sending to Lorna Schott, Intellectual Asset Management)

Inventor:	Date:	Inventor:	Date:	Inventor:	Date:
Inventor:	Date:	Inventor:	Date:	Inventor:	Date:
Witnessed, Read and Understood by:	Witness:	Date:	Supervisor:	Date:	

Invention Disclosure Form – Part 2

Docket: 48-0057

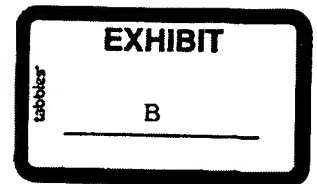
Date: November 27, 2002

Title of Invention: Communications System Enabling High Efficiency and High Linearity

Inventor(s): If there is a non-TRW inventor, please state business relationship and enclose a copy of the current Contract and Non-Disclosure Agreement. (Note: to add more inventors, please press the TAB key after the last entry in the last column to insert a new row.)

Full Name (No Initials, NMI if no middle name. Please note if you are a consultant.)	Badge No.	Core Process/ Subsidiary	CCC	TRW Mail Station	Extension	Immediate Supervisor
Ian Robinson	114030	Engineering	D652	03/1633E	22770	Jack Macek
Frank Winter	161528	RS	Q445	RC1 / 3279D	592-3301	Bill Goyette

Home Address (No P.O. Boxes)	City	State	Zip Code	Home Phone	Badge #
1079 Marco Place	Venice	CA	90291	310 452-7788	114030
13485 Grandvia Pt	San Diego	CA	92130	858 792 7591	161528



NORTHROP GRUMMAN

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Intellectual Asset Management
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Telecopier 310.812.2687
E-mail: jorna.schott@trw.com

January 27, 2003

VIA E-MAIL

Christopher P. Harris, Esq.
Tarolli, Sundheim, Covell, Tummino & Szabo L.L.P.
526 Superior Avenue
1111 Leader Building
Cleveland, Ohio 44114-1400

Subject: Docket No. 48-0057
Last Day to File Application: **N/A**
Gov't. Contract No.: **N/A**
Billing Unit: Space Technology-Engineering - Billing Code: 312

Subject: Docket No. 48-0058
Last Day to File Application: **N/A**
Gov't. Contract No.: **N/A**
Billing Unit: Space Technology-Engineering - Billing Code: 312

Dear Chris:

You should be in receipt of the above-referenced invention disclosures which were delivered to you by Ian Robinson at your invention interview this morning. No formal patentability searches will be conducted in these matters. Please provide me with draft application cost estimates.

The first draft applications should be submitted to this office by March 4, 2003. The patent applications should be prepared in accordance with the current U.S. Patent Office Rules. The draft applications and informal drawings (sketches), along with copies on disk, should be sent to me regular U.S. mail or Airborne. If you prefer to submit these by e-mail, please obtain approval from this office before submitting them PgP encryption.

Christopher P. Harris, Esq.
January 27, 2003
Page 2

Be sure to provide copies of all transmittals of drafts, documentation and comments to this office, so that I can keep track of the progress of the preparation.

Attached is a list of standards that we require for all patent application preparation. Please follow these guidelines.

The transmittal should confirm whether or not there are any potential statutory bar dates, and whether or not there are any impediments to our filing corresponding foreign applications. **Your firm is also responsible for informing us if there are any related and/or co-pending applications that are to be filed at the same time.**

So that there is no question as to division of responsibilities, this office will be responsible for the preparation of the formal papers (declaration, power of attorney, assignment) and the actual filing of the applications.

I look forward to working with you to obtain the best patent coverage we can for these inventions. If you have any questions concerning these matters, please do not hesitate to contact me.

Sincerely,

Lorna L. Schott
Patent Administrator

From: Christopher Harris
To: ian.robinson@trw.com
Date: 5/8/03 3:01PM
Subject: Docket No. 48-0057 (Our Ref: NG(ST)-6445)

Hi Ian,

Attached is a first draft patent application and related drawings in connection with the above-identified disclosure.

Please review the application for technical accuracy and completeness. Additionally, please specifically confirm that the application describes the invention in sufficient detail so as to allow a person having ordinary skill in the art to make and use the invention without undue effort or experimentation. Please confirm that the application describes what you consider to be the best manner for practicing the invention.

This e-mail is also to confirm that you are not aware of any statutory bars (e.g., public disclosure of the invention through printed publication - foreign or domestic, public use of the invention, sale of the invention, or foreign or domestic patent applications relating to the invention) that may have an impact on the patentability of the invention.

I look forward to receiving your comments for revising and/or finalizing the application. If you have any questions, please do not hesitate to contact me.

Best Regards,
Chris Harris

Christopher P. Harris
Tarolli, Sundheim, Covell & Tummino, L.L.P.
1111 Leader Building
526 Superior Avenue
Cleveland, OH 44114
Phone: (216) 621-2234 x104
Fax: (216) 621-4072
Email: charris@tarolli.com

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CC: Christopher Harris

From: Christopher Harris
To: ian.robinson@ngc.com
Date: 6/21/03 12:22PM
Subject: Docket No. 48-0057 (Our Ref: NG(ST)-6445)

Hi Ian,

Attached is a second draft patent application redline version and related drawings in connection with the above-identified disclosure.

Please review the application for technical accuracy and completeness. Additionally, please specifically confirm that the application describes the invention in sufficient detail so as to allow a person having ordinary skill in the art to make and use the invention without undue effort or experimentation. Please confirm that the application describes what you consider to be the best manner for practicing the invention.

I look forward to receiving your comments for revising and/or finalizing the application. If you have any questions, please do not hesitate to contact me.

Best Regards,
Chris Harris

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Tarolli, Sundheim, Covell & Tummino, L.L.P.
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CC: Christopher Harris

From: Christopher Harris
To: frank.winter@ngc.com; ian.robinson@ngc.com
Date: 6/23/03 10:30AM
Subject: Docket No. 48-0057 (Our Ref: NG(ST)-6445)

Hi Ian and Frank,

We are also enclosing formal papers (Assignment and Combined Declaration and Power of Attorney) in connection with the above-identified final draft patent application.

Please execute the attached Declaration and Assignment papers by signing and dating them in the spaces provided. Also note that the Assignment must be dated twice with the declaration execution date and the assignment date. Accordingly, please write the date of your signatures in both blanks on the Assignment.

Please return the originally executed formal papers (Assignment and Declaration) to us for prompt filing with the U.S. Patent and Trademark Office.

If you have any questions or comments regarding this matter, please call us immediately.

Best Regards,
Chris Harris

Christopher P. Harris
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